Part 1. Report Cover

Retest Report Number: N/A **Retest Report Date(s):** N/A

Replacement Report Number(s): N/A - new requirement

Original Report Number: 99AYP019

Original Report Date: 6 Aug 99 **Revision Date(s):** N/A

Title: Performance Oriented Packaging Testing of an MS27684 Removable Head Drum, 4-gallon, With 1-Quart, Friction Plug (Lid), Round, Metal Cans (Quantity of 4) for Liquids, With HAZLOC® Ring – Packing Groups I, II, and III (Surface and Air Modes)

Performing Activity: LOGSA Packaging, Storage, and Containerization Center
ATTN: AMXLS-T
11 Hap Arnold Boulevard
Tobyhanna, PA 18466-5097

Responsible Individual: Francis S. Flynn

Performing Activity's Reference(s): 9HTNR; AMC 13-88

Report Type: Interim Final **DTIC Distribution:** N/A

Requesting Organization(s):
Defense Logistics Agency
Defense Distribution Center
ATTN: DDC-TO
2001 Mission Drive
New Cumberland, PA 17070

Requesting Organization's Reference(s):
1. Memorandum, DOSO-DH, subject: Performance Oriented Packaging Tests to be Performed in 1999, 1 Oct 98

2. Memorandum, HAZMATPAC®, Inc., September 12, 1995, subject not stated

3. Certification Test Report, Wyle Laboratories, Huntsville, AL 35807, Report No. 41347.22-04+AC1300, October 9, 1998

4. Shipment of rings, 27 Oct 97

Part 2. Test Results: ___ single _X_ combination ___ composite

Section I. Pre-test Conditions

For testing reported herein, a shipment of drums was received in new condition. Drums from the lot from which this drum was taken have also been performance tested with a variety of bottles and cans. The cans and rings were taken from stock.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence.

Specimen No.	Test
A	repetitive-shock vibration test flat onto bottom, drop test flat onto top, drop test flat onto drum seam, drop test diagonally onto top chime, drop test diagonally onto bottom chime, drop test stack test

Part 2. Test Results: ___ single _X_ combination ___ composite

Section II. Summary

		SPECIMEN	ALL
A.	**Drop test** - *1.8 m (PG I SG 1.2, PG II SG 1.8, PG III SG 2.7)*		**PASS**
	flat onto the bottom	PASS	
	flat onto the top	PASS	
	flat onto sidewall seam	PASS	
	diagonally onto top chime	PASS	
	diagonally onto bottom chime	PASS	
B.	**Leakproofness test** - *restrained under water/soap over seams*		N/A
	production testing, 20 kPa, 5 min.	N/A	
	design qualification, 20 kPa, 5 min.	N/A	
	salvage drum requirement, 20 kPa, 5 min.	N/A	
C.	**Internal pressure/Hydrostatic pressure test** (liq.) -		
	95 kPa, ring manufacturer's testamentary	not performed	
	15 psig (100 kPa), capable by specification	not performed	
D.	**Stacking test -** *static load; 2,000 lb, 24 hr*		**PASS**
E.	**Vibration standard -** *repetitive-shock, rotary motion* 3.53 *Hz*., 1 hr		**PASS**
F.	**Water resistance test** (fiberboard box) -		N/A
G.	**Compatibility test** (liq. in plastics) –		N/A

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment. This report is/~~is not~~ applicable to transportation by air.

Part 2. Test Results (continued)

Section III. Discussion

Note. Alpha designations denote which specimen tested in that orientation.

A. Drop test: *49 CFR §178.603*

___ cold conditioned (0° F, 72 hr)
_X_ ambient conditions
___ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A[1]	1.8 m	Flat onto drum bottom	Pass. No leaks/rupture; entire contents retained
A[1]	1.8 m	Flat onto drum top	Pass. No leaks/rupture; entire contents retained
A[1]	1.8 m	Flat onto sidewall seam	Pass. No leaks/rupture; entire contents retained
A[1]	1.8 m	Diagonally onto top chime, at/near bolt	Pass. No leaks/rupture; entire contents retained
A[1]	1.8 m	Diagonally onto bottom chime, at/near bolt	Pass. No leaks/rupture; cans retained completely within the drum; cans were dented; absorbent material had settled.

Note 1. Specimen A is a combination packaging consisting of a 4-gal MS27684 removable head drum (outer packaging) containing four 1-qt, friction plug metal cans fitted with HAZLOC® rings. The ring-fitted cans (inner packagings) were filled with water (SG 1.0) to 98% of maximum capacity (based on weight).

B. Leakproofness test: *49 CFR §178.604*

N/A. Leakproofness testing of inner packagings in combination packagings is not required.

C. Internal Pressure/Hydrostatic Pressure test: *49 CFR §178.605*

Testing for the maintenance of internal pressure is not required for combination configurations for surface modes. For transportation by air, *49 CFR §173.27* applies (packagings for which retention of liquid is a basic function must be capable of withstanding without leakage...).

a. Ring-fitted cans. Testing was actually accomplished by a third-party laboratory (Wyle Laboratories), on behalf of the HAZLOC® ring manufacturer (HAZMATPAC®, Inc.). A test report (No. 41347.22-04) was provided. The rings had been tested with three 1-quart cans, manufacturer not identified.

Reported Testing--	___	250 kPa (36 psi)	for	___	5	___	30 minutes
	_X_	100 kPa (15 psig)	for	_X_	5	___	30 minutes
	___	80 kPa (12 psi)	for	___	5	___	30 minutes
	___	95 kPa (14 psi)	for	___	5	___	30 minutes
	___	75 kPa (11 psi)	for	___	5	___	30 minutes
	___	15 psi/103.4 kPa	for	___	5	___	30 minutes

Part 2. Test Results: Section III (continued)

By testing at a higher test pressure (100 kPa, 15 psig (reported)), the minimum test pressure required for combination packagings for air transportation of PG III Class 3 or Division 6.1 lading (75 kPa) was reported to have been reached and maintained. Actually, 75 kPa equals 10.9 psi, as derived by dividing 75 kPa by 6.894757 kPa per psi.

The minimum test pressure required for combination packagings for air transportation (95 kPa) was reported to have been reached and maintained. Actually, 95 kPa equals 13.8 psi, as derived by dividing 95 kPa by 6.894757 kPa per psi.

Based on the reported testing, 1-quart friction lid cans fitted with HAZLOC® rings, are capable of maintaining the minimum internal pressure required for transportation by aircraft.

b. MS27684 drum. By specification (MIL-D-6054), an MS27684 drum must have been tested hydrostatically at 15 psi for 5 minutes.

Specification Testing (capability assessment)—

___	250 kPa (36 psi)	for	___	5	___	30 minutes
___	100 kPa (15 psi)	for	___	5	___	30 minutes
___	80 kPa (12 psi)	for	___	5	___	30 minutes
___	95 kPa (14 psi)	for	___	5	___	30 minutes
___	75 kPa (11 psi)	for	___	5	___	30 minutes
X	15 psi/103.4 kPa	for	X	5	___	30 minutes
___	_____ kPa/____ psi	for	___	5	___	30 minutes

By testing at a higher test pressure (15 psi), the minimum test pressure required for combination packagings for air transportation of PG III Class 3 or Division 6.1 lading (75 kPa) was to have been reached and maintained. Actually, 75 kPa equals 10.9 psi, as derived by dividing 75 kPa by 6.894757 kPa per psi.

The minimum test pressure required for combination packagings for air transportation (95 kPa) was to have been reached and maintained. Actually, 95 kPa equals 13.8 psi, as derived by dividing 95 kPa by 6.894757 kPa per psi.

Based on the marked specification (MS27684), the 4-gal drums are capable of maintaining the minimum internal pressure required for transportation by aircraft.

Part 2. Test Results: Section III (continued)

D. Stacking test: *See 49 CFR §178.606.*
___ standard conditions (23° C & 50% RH)
_X_ ambient conditions (~72° F)
___ high temperature conditions (104° F)

No.	Length	Type	Load/Force	Peak Force	Results	Stability Maintained?
A[1]	24 hr	Static	2,000 lbf[2]	N/A lbf	Pass. No leakage	Yes

Note 1. Specimen A, 4-gallon MS27684 removable head drum, tested empty.

Note 2. The minimum top load (296 lb) to be applied was based on the anticipated gross packaged weight derived from the density of the heaviest liquid anticipated (SG = 2.7) at 98% of overflow capacity.

E. Vibration test: *See 49 CFR §178.608.*

No.	Frequency	Duration	Results
A[1]	3.53 Hz	1 hr	Pass. No leakage, rupture, or damage[2]

Note 1. Specimen A is a combination packaging consisting of a 4-gal MS27684 removable head drum (outer packaging) containing four 1-qt, friction plug metal cans fitted with HAZLOC® rings. The ring-fitted cans (inner packagings) were filled with water (SG 1.0) to 98% of maximum capacity (based on weight).

Note 2. The drum and cans remained closed, and the contents were completely retained inside the drum. The drum was not opened before proceeding to the drop test. With the use of generic cans, it was not possible to evaluate whether any actual hazardous lading could leak from the cans under conditions of repetitive-shock vibration.

F. Water resistance (Cobb Method) test: *49 CFR §178.516*
N/A. This test is only for fiberboard, as required by the standards for fiberboard boxes.

G. Compatibility test (plastics packagings only): N/A
Compatibility testing (a procedure specified in appendix B to part 173, as required by *49 CFR §173.24(e)(3)(ii))* is only required for plastics packagings intended to contain *liquid* hazardous materials.

Part 2. Test Results (continued)

Section IV. Notes

For this configuration, either *firmly packed*, fine grade vermiculite or either of the following, *firmly packed* cellulose fiber absorbent products, ”HAZMATPAC® Absorbent A-900” or "Absorption Corporation Absorbent GP", can be used without any notable difference in performance. **Inner packagings have a tendency to migrate if the loose fill material is not firmly packed.**

Variation 4 for selective testing of combination packagings, found in 49 CFR §178.601(g)(4), authorizes each external dimension (length, width, and height) to be less than or equal to the corresponding dimension of the tested design type. This allows lessening of the dimensions to provide a snug fit around the packaged lading. The gross weight of the packaging must not exceed the tested weight, and the thickness of cushioning cannot be less than the thickness used in the tested configuration.

For air transportation, **a new gasket, which has never been applied, must be used,** if the drum is to be capable of maintaining the designated internal pressure per 49 CFR §173.27(c).

Part 3. Test Personnel

A. Drop test (*49 CFR §178.603*)

B. Leakproofness test (*49 CFR §178.604*) - N/A

C. Internal pressure/Hydrostatic pressure test
(*49 CFR §173.27*) – not performed (ring manufacturer's testamentary)
not performed (drum specification capability)
(*49 CFR §178.605* - N/A

D. Stacking test (*49 CFR §178.606*)

E. Vibration standard (*49 CFR §178.608*)

F. Water resistance standard (*49 CFR §178.516*) – N/A

G. Procedure for Testing Compatibility and Rate of Permeation in Plastic Packaging and Receptacles
(*49 CFR §173.24, app B to part 173*) – N/A

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

Part 4. References

A. Title 49 Code of Federal Regulations, Parts 173 and 178, October 1, 1998 edition

B. International Air Transport Association Dangerous Goods Regulations, 40th edition, 1 January 1999

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test)

G. Recommendations on the Transport of Dangerous Goods, sixth revised edition, United Nations, New York, 1990

H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/ MCO 4030.40A, Packaging of Hazardous Material, 23 Jul 96

Part 5. Equipment

Item	Manufacturer	Serial No.	Calibration Expiration Date
6-inch dial calipers	Brown & Sharp Switzerland	599-5794	2/00
1,250-lb vibration table	L.A.B Skaneateles, NY	8120179	*see note*
4,000-lb vibration table	Gaynes Engr. Co. Franklin Park, IL	G20765	*see note*
12,000-lb vibration table	M/RAD Woburn, MA	563-84	*see note*
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/00
5,000-lb compression tester	L.A.B Skaneateles, NY	1107050	4/00
10,000-lb scale	J.J. McIntyre & Sons Whitehall, PA	5931A	4/00
5,000-lb scale	Fairbanks Scale USA	H519240	4/00
500-lb scale	Toledo Scale Worthington, OH	N/A	4/00
5,000-gram scale	Ohaus Corporation USA	20078	N/A (new)
3,000-gram balance	Brinkmann Instruments Westbury, NY	3103120	4/00
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
drop tester	L.A.B Skaneateles, NY	3811	N/R
cold chamber	Russells Holland, MI	1962214	4/00
altitude chamber	American Research Corp. Farmington, CT	5A13622	4/00
32-channel chart recorder	Molytek, Inc. Pittsburgh, PA	870403007-2S	5/99
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R
30 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420001	4/00
100 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420002	4/00
torque wrench (150 ft.-lb)	Stanley-Proto Covington, GA	WWE30966	6/99
torque wrench (100 ft.-lb)	Stanley-Proto Covington, GA	WUK50305	7/99
torque wrench (50 in.-lb)	Stanley-Proto Covington, GA	5A98	N/A (new)
torque wrench (200 in.-lb)	Stanley-Proto Covington, GA	WYC22958	N/A (new)

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Part 5. Equipment (continued)

Item	Manufacturer	Serial No.	Calibration Expiration Date
400 kPa pressure gauge	Ashcroft Stratford, CT	45323-016A	11/00
400 kPa pressure gauge	Ashcroft Stratford, CT	5323-016B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59694-011B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59695-011A	11/00

Appendix A

Test Applicability

Based on the drop height and computed stacking weight, this test report is applicable for all surface modes of transportation including road, rail, and water, when the liquid hazardous substance intended for containment by the tested packaging is in accordance with the equivalencies listed in appendix B, section III of this report. Transportation by commercial (cargo and passenger) or military air is as permitted by regulation for the hazardous item, provided the required pressure for the hazardous lading does not exceed 100 kPa. A test pressure based on the vapor pressure of the intended liquid contents applies. Appropriate packaging paragraphs apply.

Pass/fail conclusions were based on the particular cans, rings, and drum specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters. **Extrapolation of test results to other locking ring brands is not authorized**.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings.

Testing was performed per *Title 49* Code of Federal Regulations; *Subtitle B*, Other Regulations; *Chapter I*, Research and Special Programs Administration (DOT); *Subchapter C*, Hazardous Materials Regulations; *Part 173*, Shippers- General Requirements for Shipments and Packagings; *Part 173 Subpart A*, General; as well as, *Part 178*, Specifications for Packagings; and *Part 178 Subpart M*, Testing of Non-Bulk Packagings and Packages.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). **The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s).** ***Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).***

Appendix A (Continued)

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested drum, or friction-lid cans with locking rings. Packaging paragraphs apply.

Appendix B

Test Data Sheet

Section I. Test Product

Physical State: ___ solid _X_ liquid ___ gas ___ aerosol

Test Product Used: Water

Amount Per Container:
1-quart (4 qt), rated
2.08 lb (8.32 lb)
2.34 lb (9.36 lb), packed

Test Weight: ~10.4 kg

Gross Weight: ~23 lb (Gross Weight = Test Weight x 2.205 lb/kg, rounded)

Consistency/Viscosity: N/A

Flash Point: N/A

Additional Description: N/A

Appendix B (Continued)

Section II. Test Parameters

Drop Height: Ref: *49 CFR §178.603*

_X_ **1.8 m**; 71 in. (PG I, II, & III, **SG ≤ 1.2** or solids)
___ 1.2 m; 47 in. (PG II & III, SG ≤ 1.2 or solids)
___ 0.8 m; 32 in. (PG III, SG ≤ 1.2 or solids)
___ ___ m; ___ in. (other, PG ___, SG ___)
from-- _X_ PG I: SG x 1.5 m, SG x 59.06 in.
_X_ PG II: SG x 1.0 m, SG x 39.37 in.
_X_ PG III: SG x 0.67 m, SG x 26.38 in.

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less. Equivalent specific gravity derived from drop height as follows--

PG factor x density (or SG) = drop height, thus
SG = drop height/PG factor (49 CFR §178.603)
0.67 m x SG = 1.8 m, thus SG = 2.7, PG III

Internal Pressure/Hydrostatic Pressure (liquids only):

___ N/A; *surface only* [49 CFR §178.605(a)]
___ N/A; *solids* [49 CFR §178.605(a)]
___ 250 kPa (36 psi); *PG I single minimum*
[49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]
___ 100 kPa (15 psi); *PG II/III single minimum*
[49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]
___ 80 kPa (12 psi); *PG III of Class 3 or Division 6.1 sgl min.*
[49 CFR §173.27(c)(3)(ii), air]
_X_ 95 kPa (14 psi); ***inner/supplementary minimum, PG N/A***
[49 CFR §173.27(c)(2)(i), air]
___ 75 kPa (11 psi); *inner/suppl. min., PG III of Cl 3/Div 6.1*
[49 CFR §173.27(c)(2)(i), air]
_X_ 15 psi/103.4 kPa; *other,* ***drum specification*** [MIL-D-6054]
other, reported **capability** [can with locking ring]
___ ___ kPa/____ psi; *other,* _____

Stacking Weight/Force: Ref: *49 CFR §178.606*
Solids-- A = (n-1)(w)(.95)
where: A = applies load in pounds
n = minimum number of containers that when stacked, reach a height of 3 m (round up to next integer)
w = maximum weight of one packed container in pounds
.95 corresponds to maximum fill (95% max. capacity)

N/A lb **minimum required;** N/A lbf actual
A = (n-1)(w)(.95)
where: n = 118 in./ in. = rounded up to
w = lb
A = (-1)(w)(.95) = lb (presumed to be 95%)

Appendix B (Continued)

Section II. Test Parameters (continued)

Stacking Weight/Dynamic Compression Force: Ref: *49 CFR §178.606*

Liquids-- A = (n-1)[w + (s)(v)(8.3)(.98)](c)

where: A = applied load in pounds
n = minimum number of containers that when stacked, reach a height of 3 m (round up to next integer)
s = specific gravity of lading
w = maximum weight of one empty container in pounds
v = actual capacity of container (rated capacity + outage) in gallons
8.3 corresponds to the weight (lb) of 1 gallon of water
.98 corresponds to maximum fill (98% max. capacity)
c = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing), or 1.0 (static top load)

199 lb **minimum required (PG I, SG 1.2)**; 2,000 lbf actual

A = (n-1)[w + (s)(v)(8.3)(.98)](c)

where: n = 118 in./14.5 in.
≈ 8.1 rounded up to 9
w = 8 + (4)(.26) + (4)(0.04) + 6 ≈ 15 lb
s = 1.2
v = (.25 gal)(4) ≈ 1.00 gal
c = 1
A = (9-1)[15 + (1.2)(1.0)(8.3)(.98)](1) ≈ 198.1 lb

238 lb **minimum required (PG II, SG 1.8)**; 2,000 lbf actual

A = (n-1)[w + (s)(v)(8.3)(.98)](c)

where: n = 118 in./14.5 in.
≈ 8.1 rounded up to 9
w = 8 + (4)(.26) + (4)(0.04) + 6 ≈ 15 lb
s = 1.8
v = (.25 gal)(4) ≈ 1.00 gal
c = 1
A = (9-1)[15 + (1.8)(1.0)(8.3)(.98)](1) ≈ 237.1 lb

296 lb **minimum required (PG III, SG 2.7)**; 2,000 lbf actual

A = (n-1)[w + (s)(v)(8.3)(.98)](c)

where: n = 118 in./14.5 in.
≈ 8.1 rounded up to 9
w = 8 + (4)(.26) + (4)(0.04) + 6 ≈ 15 lb
s = 2.7
v = (.25 gal)(4) ≈ 1.00 gal
c = 1
A = (9-1)[15 + (2.7)(1.0)(8.3)(.98)](1) ≈ 295.7 lb

Appendix B (Continued)

Section III. Equivalencies of Liquids

	Specific Gravity[1]	Total lb per Configuration	Total lb per Container	Gross Weight (pounds)[2]	Test Weight (kilograms)[2]
Water	1.0	8.32	2.08	23	10.4
PG I	1.2	10.00	2.50	25	11.3
PG II	1.8	14.96	3.74	30	13.6
PG III	2.7	22.48	5.62	37	16.8

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus
SG = drop height/PG factor (49 CFR §178.603)
PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2
PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8
PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7
Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

Note 2. Gross and test weights include packaging (~15 lb, ~6.8 kg) and liquid contents. Gross Weight = Test Weight x 2.205 lb/kg, rounded.

Appendix C

Packaging Data Sheet

Section I. Exterior Shipping Container

Packaging Category: ___ single _X_ combination ___ composite

UN Marking(s):
cited in test report-- N/A
marked on packaging-- N/A

UN Type: 1A2; Steel removable head drum (*49 CFR §178.504 (a)(2)*)

Specification Type: Drum, Metal-Shipping and Storage

Specification Number(s): MIL-D-6054; MS27684-2 (drum assembly);
MS27684-12 (bottom marked); MS27684-21 (lid marked)

Nominal (Rated) Capacity: 4 gallons (by spec., not marked)

Container Manufacturer: MIRAX (bottom marking); CAGE 85717
MIRAX Chemical Products, Corporation
St. Louis, Missouri 63139

Nomenclature: Drum, Metal (label marking)

Date(s) of Container Manufacture: 98 (embossed on bottom)

Material: Steel, 22 gauge (embossed on bottom) [2 swedges]

NSN: 8110-00-254-5722 (drum assembly)

Contract No.: N/A Purchase Order No.: N/A

Tare Weight (empty drum): 8 lb (actual, w/lid & ring)

Dimensions: 11½ in. in diameter (OD); 14½ in. in height (OD)
10.5 in. nominal inside diameter (IAW MIL-D-6054)
12.86 in. nominal usable inside height (IAW MIL-D-6054)

Closure (Method/Type):
Locking ring; nut and bolt, tightened to 6 ± ½ foot-pounds

Closure Dimensions: ¾ in. in height (OD) (locking ring)
1½ in. around (OD) (locking ring)
⅜ in. by 3½ in. (bolt)

Appendix C (Continued)

Section I. Exterior Shipping Container (continued)

Closure Specification Number(s):
MS27684-21 (drum cover, style 1); NSN 8110-00-841-1634
MS27684-31 (locking ring, style 1); NSN 8110-00-190-9992
MS27684-25 (gasket); NSN not assigned

Closure Manufacturer(s): Nut & bolt, not marked

Banding Type: N/A Banding Specification No(s).: N/A

Banding Dimensions: N/A Banding Manufacturer: N/A

Banding Position(s): N/A

Cushioning/Dunnage: Cellulose fiber absorbent; fiberboard pad

Cushioning/Dunnage Specification Type(s):
Cellulose fiber absorbent-- Absorbent™ GP
Fiberboard-- Standard Specification for Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes

Cushioning/Dunnage Specification Number(s):
Cellulose fiber absorbent-- proprietary
Fiberboard-- ASTM D 4727, type CF (corrugated fiberboard)
Variety SW (singlewall), C flute
Class WR (weather-resistant)
Grade V3c

Cushioning/Dunnage Dimensions: see Additional Description
Cellulose fiber absorbent-- ungraded, approximately 6 lb
Fiberboard-- 10 in. diameter (pad between layers, qty 1)

Cushioning/Dunnage Manufacturer(s):
Cellulose fiber absorbent-- Absorption Corp., Bellingham, WA
Fiberboard-- Not identified

Leakproof Liner(s): None
Note 1. Each ring-fitted can may be placed in a sealed plastic bag.
Note 2. Using the drum dimensions, if a 4-mil drum liner were used,

the bag width should be--		the bag depth should be--
[w_{drum} + 7]	[w_{drum} + h_{drum} + 7]	
[11 + 7]	[11 + 13 + 7]	
~18	[11 + 13 + 7]	
	~31	

Liner Manufacturer/Distributor and Part No.(s): N/A

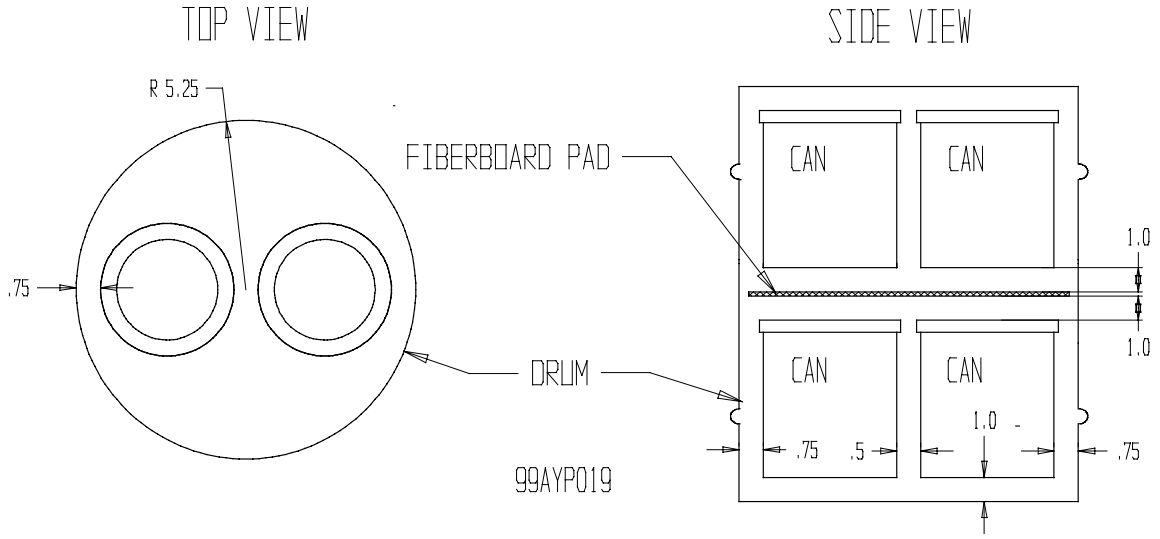
Appendix C (Continued)

Section I. Exterior Shipping Container (continued

Additional Description:

a. A plastic liner (bag) may be placed either in the drum or around each can. The use of a leakproof liner or leakproof bag is optional for this configuration, since the outer packaging is leakproof.

b. Approximately 1 inch of loose-fill absorbent was placed in the bottom of the drum, and firmly tamped down. Two ring-fitted cans were placed on the loose-fill absorbent cushioning, evenly spaced. More loose-fill absorbent was then tightly packed around and over the cans. Less than 1 inch (approx. ½ in.) of tightly packed loose-fill absorbent separated the cans from each other. Less than 1 inch (approx. ¾ in.) of loose-fill absorbent separated the cans from the sides of the drum. Approximately 1 inch of firmly packed loose-fill absorbent covered the evenly spaced ring-fitted cans. A fiberboard pad was placed on the layer of absorbent cushioning. Approximately 1 inch of loose-fill absorbent was placed on the fiberboard pad. Two ring-fitted cans were placed on the absorbent cushioning, evenly spaced. More loose-fill absorbent was tightly packed around and over the ring-fitted cans. Approximately 1 inch of loose-fill absorbent covered the cans. **The loose-fill absorbent must be firmly packed, especially toward the drum bottom chime. The loose-fill absorbent must completely fill the drum, up to the rim.**



Appendix C (Continued)

Section I. Exterior Shipping Container (continued

c. Before closing, the drum was “shaken down” to settle and pack the absorbent material. Additional absorbent was added, as necessary to make a tight pack. If used, the plastic bag is to be rolled/ folded down, then taped across the fold. The bag ends are to be folded down, along the sides of the drum.

d. The quantities of absorbent material ~~DO~~/DO NOT meet the 1-quart guidelines for absorbent material (1 in. sides, 2 in. top/bottom) outlined in AFJMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19F/ DLAM 4145.3, Preparing Hazardous Materials for Military Air Shipments.

e. When used, care must be exercised when selecting vermiculite to avoid introducing water or surfactants (treatments to reduce dust) into the package. Only untreated vermiculite should be used. The use of CID A-A-52450, Vermiculite, Absorbent (For Packaging Liquid Hazardous Materials) is recommended.

Appendix C (Continued)

Section II. Primary Inner Packaging of Combination Packaging
Applicable/~~Not applicable~~

Quantity of Inner Containers: 4

Capacity: 1 quart each

Specification Type and No(s).: N/A NSN: N/A

Type: 1-quart tripletite paint can (distributor's description);
friction plug (lid)

Manufacturer/Distributor: Freund Can Company
Chicago, Illinois 60620 (box marked)

Manufacturer/Distributor Part Number(s): can–1818A
bail–N/A
lid–6618A

Contract and Purchase No(s).: Not marked

Material(s): Steel, tin plate

Date(s) of Manufacture: N/A

Tare Weight (empty can): .26 lb; 117.9 g (avg) [120.4 g w/ring]

Filled Weight: 2.34 lb

Dimensions: 4⅛ in. - diameter (OD) [can body w/o handles]
4⅞ in. - height (OD)

Closure Type: Friction plug
404 tripletite lid (distributor’s description)

Closure Method: See Additional Description

Closure Specification and Number(s): N/A

Closure Dimensions: 3½ in. (opening)

Closure Manufacturer/Distributor and Part No(s).:
Freund Can Company, P/N 6618A

Appendix C (Continued)

Section II. Inner Packaging (continued)

Secondary Closure: Plastic locking ring

Secondary Closure Specification(s): HAZMATPAC® P/N C-GSA-705
NSN-- N/A

Secondary Closure Specification Number(s): NSN-- N/A

Secondary Closure Dimensions: N/A

Secondary Closure Manufacturer(s): HAZMATPAC®, Inc., Houston, TX

Secondary Closure Contract No.: N/A

Secondary Closure Purchase Order No.: N/A

Secondary Closure Date of Manufacture: Not identified

Cushioning/Dunnage Type: see Appendix C, Section I

Cushioning/Dunnage Dimensions: N/A

Cushioning/Dunnage Specification Type and Number(s): N/A

Cushioning/Dunnage Manufacturer: N/A

Leakproof Liner: N/A

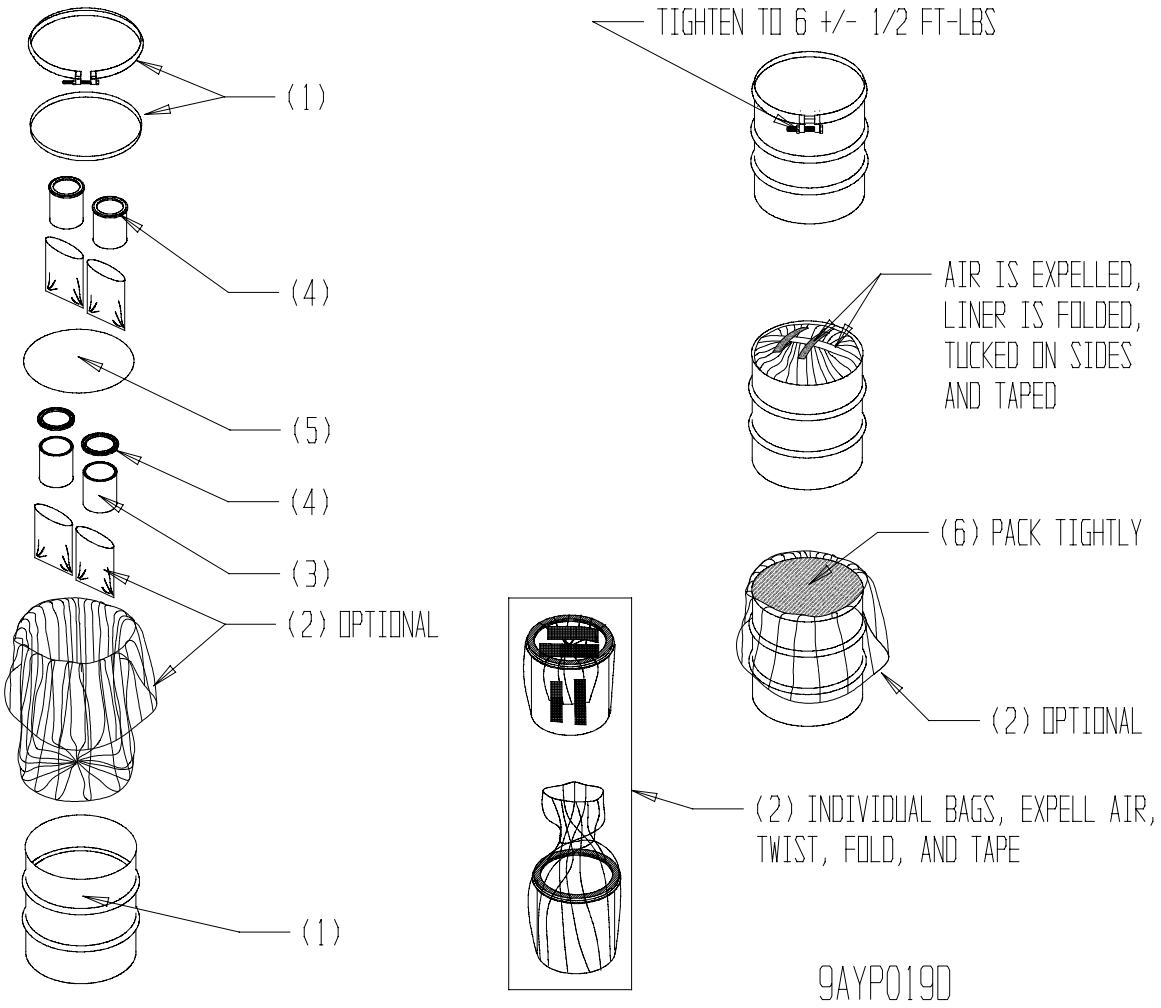
Static Electricity Protection: N/A

Additional Description: **This test report can only be cited when a HAZLOC® ring is applied to the cans.**

A multilock closure device (Freund Can Co., stock No. 7855, compression press) was used to separately press the friction lid and plastic locking ring securely into place. Care must be exercised to avoid denting or creasing the friction-lid cans.

Appendix C (Continued)

Section III. Drawing



ITEM	DESCRIPTION 99AYP019
1	4 GAL., DRUM, METAL-SHIPPING & STORAGE, OPEN HEAD, IAW MIL-D-6054, NSN: 8110-00-254-5722, MS 27684-2
2	PLASTIC DRUM LINER, 4-MIL POLYETHYLENE, 18 X 31 IN. (OPTIONAL) or AN INDIVIDUAL BAG FOR EACH CAN (QTY 4), 4-MIL POLYETHYLENE (OPTIONAL)
3	QTY 4, 1-QUART FRICTION PLUG (LID), ROUND, METAL CAN
4	LOCKING RING – HAZLOC BRAND (NO SUBSTITUTION) P/N C-GSA-705
5	FIBERBOARD PAD, GRADE W5c or V3c IAW ASTM D 4727, 10 IN. DIAMETER
6	CELLULOSE FIBER ABSORBENT, OR VERMICULITE, A-A-52450

Appendix D

Rationale

The equivalent of Packing Group I (great danger) testing was requested for a 4-gallon, MS27684 removable head drum, having as the intended contents four, 1-quart, friction plug (lid), round, metal cans fitted with HAZLOC® Rings. The cans are more commonly known as paint cans. The configuration to be tested is intended to be applicable to a large assortment of liquid products contained in round, friction plug (paint), metal cans, in volumes of 1-quart, 1-pint, or less. For lesser volumes, variations to testing requirements can be found in 49 CFR §178.601(g).

Water was used as the test liquid as permitted by Title 49 Code of Federal Regulations (CFR). Substitution for the actual hazardous lading is permitted by *49 CFR §178.602(c).*

Cellulose fiber absorbent was used as an absorbent material and/or cushioning. A plastic bag, tightly folded, and securely taped, can be used (not required) as a leakproof liner inside the drum. The cans may be placed inside a leakproof, sealed plastic bag. The use of a leakproof liner or leakproof bag is optional for this configuration, since the outer packaging is leakproof.

Prior to closing the 4-gallon, MS27684 removable head drum, a fiberboard top pad *was not* placed on top of the absorbent. A circular fiberboard pad separated the 2 layers of cans.

Per the requesting activity, a HAZLOC® locking ring was used as a secondary closure.

A multilock closure device (compression press) was used to separately press the friction lid and plastic locking ring securely into place. Care must be exercised to avoid denting or creasing the friction-lid cans. Each can *was not* placed inside a sealed plastic bag.

One combination packaging made to the above described configuration was subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. After the rough handling testing of the packed drum, static loading was performed on the empty drum. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications.

Appendix D (Continued)

In conducting the drop test, the packed drum was dropped first flat onto the bottom, followed by a drop flat onto the top, a drop flat onto the seam side, a drop diagonally onto the top chime, and a drop diagonally onto the bottom chime. Between all drop orientations, the drum was dropped onto five different surfaces or edges. One drop per drum is the **minimum** per 49 CFR requirements. The decision to use the same container (configuration) for all drops was based on the relatively minimal damage demonstrated during previous testing. Five drops per drum exceeds 49 CFR §178.603 requirements, as well as both UN and ASTM recommendations *(i.e., one drop diagonally onto a chime, and one drop on the next weakest part, each orientation repeated three times using six samples total).* It should be noted that the use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 40302.2/MCO 4030.40, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

Due to the variety of items to be packaged, testing was actually conducted according to the parameters for dense liquids (those with specific gravity up to 1.8) belonging to Packing Group II. This would equate to rough handling tests equivalent to those for Packing Group I for liquids having a specific gravity of 1.2 or less, and for Packing Group III liquids having specific gravity 2.7 or less.

For the drop test (*49 CFR §178.603*), a free fall drop table, set for 1.8 meters (71 in.), was used. The impact surface was the ½-inch steel impact plate of the table, which was bolted to the concrete floor.

The leakproofness test (*49 CFR §178.604*) of the metal cans is not required, because the cans are inner packagings in a combination packaging.

The hydrostatic pressure test (*49 CFR §178.605*) is a test to be performed for single packagings, and is not required for inner packagings of combination packagings. For internal pressure requirements for inner packagings of combination packagings intended for transportation by aircraft, *49 CFR §173.27(c)* applies. For combination packagings to be transported by air, if the inner packaging is not able to maintain the designated internal pressure (49 CFR §173.27(c)(3)(i)), the inner packagings may be packed in a supplementary packaging which does meet the pressure requirements.

According to test documentation and certification provided by the manufacturer of the HAZLOC® ring, a 1-quart friction lid can fitted with the HAZLOC® ring is capable of maintaining a 95 kPa

Appendix D (Continued)

internal pressure. The minimum internal pressure of 95 kPa (14 psi) is stipulated for liquids other than Packing Group III in Class 3 or Division 6.1 (49 CFR §173.27(c)(2)(i)), for which a minimum internal pressure of 75 kPa (11 psi) is required. Therefore, for transportation by aircraft, the configuration, as tested, would be authorized, and the cans with the HAZLOC® rings were shown to be *capable* of withstanding without leakage an internal pressure as caused by changes in altitude and temperature during transportation aboard aircraft.

According to the military specification to which the drum is constructed (MIL-D-6054), the drum must have demonstrated the ability to maintain 15 psi internal pressure, which is greater than 95 kPa (14 psi), the minimum internal pressure stipulated for liquids other than Packing Group III in Class 3 or Division 6.1 (49 CFR §173.27(c)(2)(i)), for which a minimum internal pressure of 75 kPa (11 psi) is required. Therefore, for transportation by aircraft, the configuration, as tested, would be authorized, as the drum is to have demonstrated that it is *capable* of withstanding without leakage an internal pressure as caused by changes in altitude and temperature during transportation aboard aircraft.

As the configuration being tested is a combination packaging, it is not subject to the single packaging hydrostatic pressure *test (49 CFR §178.605)* and marking requirements of 49 CFR §178.503(a)(5). More clearly stated, a hydrostatic pressure test of 250 kPa (36 psi) for liquids in Packing Group I is not applicable, unless 250 kPa is the pressure related to the vapor pressure of the liquid to be conveyed, as computed based on the vapor pressure of the lading at 50^{o} C or 55^{o} C.

For the stack test (*49 CFR §178.606*), a 5,000-lb capacity compression tester was used because it could hold the load constant for the required 24-hour timeframe. The total top load (2,000 lb) was greater than the minimum required based on the density of the heaviest liquid anticipated at 98% of maximum capacity, and the outer drum height. The top load was to simulate a stack of identical packagings which might be stacked on the packaging during transport. The minimum height of the stack could not be less than 3 meters (118 in.), so the number of packagings (stack height minimum divided by assembled drum height) had to be represented by an integer number, which had to be rounded up, without respect to which was the nearest whole number.

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (*49 CFR §173.24a(a)(5)*), the vibration test (*49 CFR §178.608*) was performed, as a means to

Appendix D (Continued)

determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the drum/ring-fitted cans combination packaging. The ring-fitted metal inner packagings were filled with water (SG 1.0) to 98% of maximum capacity (based on weight). The combination packaging was tested using a 1,250-lb capacity vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak displacement) such that the combination packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

The Cobb Method Test for water absorptiveness was not performed, because the test is not a performance test. The Cobb Method Test, addressed in *49 CFR §178.516*, Standards for Fiberboard Boxes, is a material specification test only for the fiberboard to be used for outer packagings.

Compatibility testing (a procedure specified in appendix B to part 173, as required by *49 CFR §173.24(e)(3)(ii)*) is only required for plastics packagings intended to contain liquid hazardous materials.

Appendix E

Actual Product

Note. The item Identification Number and related Proper Shipping Name have not been identified for items to be transported in this configuration.

Name: Explosive No.:

Part No.: Drawing No.:

NSN: Type: DODIC:

Specification: RELCD:

Properties or Descriptions:
(IMO IMDG)

Proper Shipping Name(s):
49 CFR--
IATA/ICAO DGR--
AFJMAN 24-204/TM38-250--
IMO IMDG--

Identification No.: **UN** Hazard Class or Division:

Packing Group: ___ I ___ II ___ III

49 CFR-- Packaging Authorization(s): **§**
Exception(s): **§**
Special Provisions:

IS/IS NOT forbidden on passenger aircraft/rail
kg maximum limitation
IS/IS NOT forbidden on cargo air,
kg gross maximum limitation

ICAO TI/IATA DGR--
Packing Instruction(s): passenger aircraft--
cargo aircraft--
Special Provisions:
IS/IS NOT forbidden by passenger air, ___ kg maximum limit
IS/IS NOT forbidden by cargo air, ____ kg G max. limitation

IATA State Variations:
IATA Operator Variations:

IMO IMDG Code Packagings: Schedule , stowage
Packing Method

Appendix E (Continued)

NSN (continued):

AFJMAN 24-204/TM 38-250--
Packaging Paragraph:
Special Provisions:
WAS/WAS NOT a theta item (duty passengers)
WAS/WAS NOT a dagger item (no passengers)
Note. The theta/dagger designations were eliminated in the 1 Mar 97 revision to AFJM 24-204, and replaced with Special Provisions codes.

Amount Per Container (Configuration): _____ gallons

Net Explosive Weight: kg each
kg total

Density/Specific Gravity:

Vapor Pressure at 50° C:
55° C:
70° F: mm Hg

Flash Point: ___ N/A _____° C _____° F

Consistency/Viscosity: N/A

Interim Hazard Classification Ref(s).: N/A

Electrostatic Discharge Protection: Required/not required

Shelf Life Item? ___ Yes ___ No

Additional Description: N/A